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(54) Title: WATERMARKING OF DIGITAL IMAGE DATA

(57) Abstract

Digital watermarks can serve to indicate copyright ownership of digitized video. When video images are transmitted as transformed by discrete cosine transformation (DCT) for compression, with or without motion compensation, it is advantageous to include a watermark *after* transformation. To this end, a DCT watermark is generated for optimal visibility based on the original image data, and the generated watermark is superposed on the transformed data.

WATERMARKING OF DIGITAL IMAGE DATA

Priority is claimed based on U.S. Provisional
Application No. 60/063,509, filed October 27, 1997.

Technical Field

This invention relates to providing digital image
5   data with a watermark, and, more particularly, where the
image data are video data.

Background of the Invention

A conventional watermark, on a paper document, may
consist of a translucent design which is visible when the
10 document is held to the light. Or, more generally, a
watermark may be viewed under certain lighting conditions
or at certain viewing angles. Such watermarks, which are
difficult to forge, can be included for the sake of
authentication of documents such as bank notes, checks
15 and stock certificates, for example.

In digital video technology, watermarks are being
used to betoken certain proprietary rights such as a
copyright, for example. Here, the watermark is a visible
or invisible pattern which is superposed on an image, and
20 which is not readily removable without leaving evidence
of tampering. Resistance to tampering is called
"robustness".

One robust way of including a visible watermark in a
digitized image is described by Braudaway et al.,
25 "Protecting Publically Available Images with a Visible
Image Watermark", IBM Research Division, T. J. Watson
Research Center, Technical Report 96A000248. A luminance
level, ΔL, is selected for the strength of the watermark,
and the luminance of each individual pixel of the image
30 is modified by ΔL and a nonlinear function. For
increased security, the level ΔL is randomized over all

the pixels in the image.

Summary of the Invention

When images are transmitted as transformed by
discrete cosine transformation (DCT) for compression,
5   with or without motion compensation, it is advantageous
to include a watermark *after* transformation. To this
end, (i) a DCT watermark is generated for optimal
visibility based on the original image data, and (ii) the
generated watermark is superposed on the transformed
10 data.

Brief Description of the Drawing

Fig. 1 is an illustration for motion-compensated
discrete cosine transformation (MC-DCT).

Fig. 2a is a watermark mask.

15 Fig. 2b is an original image.

Fig. 2c is a superposition of the original image and
the watermark mask.

Fig. 3 is a flow diagram of initial processing.

Fig. 4 is a flow diagram of watermark superposition
20 processing.

Fig. 5 is a flow diagram of scaling for a region.

Detailed Description

A Mask Generation Module generates a DCT watermark
mask based on the original video content. A Motion
25 Compensation Module efficiently inserts the watermark in
the DCT domain and outputs a valid video bitstream at
specified bitrate. The following description applies
specifically to image data in MPEG format.

MPEG video consists of groups of pictures (GOP) as
30 described in document ISO/IEC 13818 - 2 Committee Draft
(MPEG-2). Each GOP starts with an intra coded "I-frame",
followed by a number of forward-referencing "P-frames"

and bidirectionally-referencing "B-frames".

With motion compensation, when a watermark is inserted in an I-frame, the P- and B-frames in the GOP will be changed also. For such correction, the motion

5   compensation on the watermark in an anchor or base frame must be subtracted when the watermark is added to a current frame. For such subtraction, the technique of motion compensation in the DCT domain can be used as described by S. F. Chang et al., "Manipulation and

10   Compositing of MC-DCT Compressed Video", IEEE Journal of Selected Areas in Communications, Special Issue on Intelligent Signal Processing, pp. 1-11, January 1995.

In a video sequence, the image content changes from frame to frame. Thus, to keep a watermark sufficiently

15   visible throughout the video, the watermark must be adapted to the video contents. For example, when an image is complicated or "busy", i.e., when it has many high-frequency components, the watermark should be stronger. For different regions in the same video frame,

20   the watermark should be scaled regionally— thereby enhancing the security against tampering.

(i)   Mask Generation Module

In this module, as illustrated by Section (i) of Fig. 4, a watermark mask image is first generated for

25   each GOP, or for the first P-frame after a scene cut. This is based on the fact that video content tends to be consistent within a GOP which is usually about 15 frames or 0.5 second long. But, when there is a scene cut within a GOP, visual content will change significantly,

30   and a new mask is used to adapt to the new visual content. Thus, the watermark mask is superposed on the I-frame, or on the first P-frame after a scene cut.

To generate the mask, as illustrated by Fig. 3, the input watermark image is first converted to a gray scale

image. Only the luminance channel of each image is modified. A transparent color (background color) is chosen. The luminance of all watermark pixels having the transparent color value is set to 0. Optionally, the

5 mask image is randomly shifted in both x- and y-direction. A DCT is applied to obtain the DCT mask of the watermark. The luminance of the mask will be scaled adaptively according to the input image content before adding to the input image.

10   In the pixel domain, the following formulae have been proposed in the above-referenced report by G. W. Braudaway et al.:

$$w_{nm}' = w_{nm} \cdot y_w/38.667 \cdot (y_{nm}/y_w)^{2/3} \cdot \Delta L \text{ for } y_{nm}/y_w > 0.008856,$$
$$w_{nm}' = w_{nm} \cdot y_w/903.3 \cdot \Delta L \text{ for } y_{nm}/y_w \leq 0.008856 \qquad (1)$$

15 where w_{nm}' is the scaled watermark mask that will be added to the original image, w_{nm} is the non-transparent watermark pixel value at pixel (n,m), y_w is the scene white, y_{nm} is the luminance value of the input image at image coordinates (n,m), and ΔL is the scaling factor
20 which controls the watermark strength.

In accordance with an aspect of the present invention, for scaling in the DCT domain, a stochastic approximation can be used. If y_{nm} and w_{nm} are considered as independent random variables, if y is normalized to
25 the luminance range used in MPEG, namely from [0, 255] to [16, 235], and if $y_w = 235$, then, based on Equations 1, the expected values of w' are

$$E[w'] = 0.1607 \cdot E[w] \cdot E[y^{2/3}] \cdot \Delta L \ ; \quad y > 17.9319$$
$$E[w'] = 0.2602 \cdot E[w] \cdot \Delta L \ , \qquad y \leq 17.9319 \qquad (2)$$

Assuming that y has a normal distribution with mean
30 α and variance β^2, the $E[y^{2/3}]$-term in Equation (2) can be represented as

5

$$E[y^{2/3}] = \int_{17.9319}^{235} t^{2/3} \cdot \frac{1}{\sqrt{2\pi\beta^2}} e^{\frac{(t-\alpha)^2}{2\beta^2}} dt = f(\alpha, \beta^2) \tag{3}$$

Thus, $E[y^{2/3}]$ is a function of the mean and the variance of the pixel values.

Equation (2) specifies a relationship between the moments of random variables w, w' and y. This relationship can be extended to the deterministic case to simplify Equation (2), resulting in a linear approximation.

For each 8 by 8 image block, the mean and variance of the block are used to approximate α and β^2 in Equation 3, and the mean α is used to approximate y in deciding which of the formulae to use in Equation 2.

$$w'_{ijk} = 0.1607 \cdot w_{ijk} \cdot f(\alpha, \beta^2) \cdot \Delta L, \quad \alpha > 17.9319 .$$
$$w'_{ijk} = 0.2602 \cdot w_{ijk} \cdot \Delta L, \quad \alpha \leq 17.9319 \tag{4}$$

where, for k = 0, ..., 63, w_{ijk} is the k-th pixel of the i,j-th 8 by 8 block in the watermark image. w'_{ijk} is for the scaled watermark.

Equation 4 approximates the nonlinear function according to Equation 2, by linear functions block by block. The scaled watermark strength depends on the mean and variance of the image block. For each image block, the higher the mean (i.e. the brighter), and the higher the variance (i.e. the more cluttered), the greater the required strength of the watermark for maintaining consistent visibility of the watermark.

The DCT of Equation 4 can be used to obtain the DCT of the watermark mask, which can be inserted in the image in the DCT domain. The mean and variance of the input image can be derived from the DCT coefficients,

$$\alpha = (Y_{DC}/8) \text{ and} \tag{5}$$

$$\beta^2 = Var(y) = \frac{\sum_{i=0}^{63} Y_i^2}{64} - \frac{Y_{DC}^2}{64} = \frac{\sum_{i=1}^{63} Y_i^2}{64} = \frac{(\sum Y_{AC}^2)}{64} \tag{6}$$

where Y_{DC} and Y_{AC} are DC- and AC-DCT coefficients, respectively, of the image block Y.

A new watermark mask is calculated for each I-frame and P-frame, the latter in case of a scene cut. For I-
5   frames, all DCT coefficients are readily accessible after minimal decoding of the MPEG sequence, i.e. inverse variable length coding, inverse run length coding and inverse quantization. For P-frames, since most blocks are in the scene cut, these DCT coefficient can be used
10   immediately. For non-intra coded blocks, the average DC and AC energy obtained from intra coded blocks are substituted.

For further speed-up, the block-based $(\alpha_{ij}, \beta_{ij})$ pair can be replaced by the average $(\bar{\alpha}, \beta)$ over the whole image
15   or over certain regions. In the following, a multi-region approach is described.

The input image can be separated into many rectangular regions. As illustrated by Fig. 5, for each region an $(\bar{\alpha}, \beta)$ pair is calculated, and the mask is
20   generated accordingly. Typically, the watermark is divided into top and bottom regions. This is suitable for most outdoor views with sky in the upper half of the frame and darker scenery in the lower half, as shown in Fig. 2a, for example. Each region will have a relatively
25   visible watermark using different $(\bar{\alpha}, \beta)$ pairs.

To enhance the security of the watermark further, a randomized location shift can be applied to the watermark image before applying the DCT. This makes removal of the watermark more difficult for attackers who are in
30   possession of the original watermark image, e.g. when a known logo is used for watermark purposes. Sub-pixel randomized location shifting will make it very difficult for the attacker to remove the watermark without leaving some error residue.

The following can be used for shifting. Two random
numbers, for x- and y-direction, respectively, are
generated and normalized to lie between -1.00 to 1.00. In
the spatial domain, sub-pixel shifting is effected by
bi-linear interpolation which involves only linear scaling
and addition. In the DCT domain, a similar bi-linear
operation can be used.

(ii) Motion Compensation Module

Once the DCT blocks of the watermark have been
obtained, they are inserted into the DCT frames of the
input video in one of three ways, as illustrated by Fig.
4, Section (ii). For I-frame or intra coded blocks in the
B- or P-frames, the DCT of the scaled watermark is added
directly:

$$E'_{ij} = E_{ij} + W'_{ij} \tag{7}$$

where E'_{ij} is the i,j-th resulting DCT block, E_{ij} the
original DCT block, and W'_{ij} the scaled watermark DCT
according to Equation 6.

For blocks with forward motion vector in P-frame, or
backward motion vector only in B-frame, the watermark
added in the anchor frame has to be removed when adding
the current watermark. The resulting DCT error residue
is:

$$E'_{ij} = E_{ij} - MCDCT(W'_F, V_{Fij}) + W'_{ij} \tag{8}$$

where MCDCT is the motion compensation function in the DCT
domain as described in the above-referenced paper by S.-F.
Chang et al. W'_F is the watermark DCT used in the forward
anchor frame, and V_{Fij} is the forward motion vector, as
shown in Fig. 1.

For bidirectional predicted blocks in B-frame, both
forward and backward motion compensation has to be

averaged and subtracted when adding the current watermark:

$$E'_{ij} = E_{ij} - (MCDCT(W'_F, V_{Fij}) + MCDCT(W'_B, V_{Bij}))/2 + W'_{ij} \quad (9)$$

where V_F and V_B are forward and backward motion vector, respectively, as shown in Fig. 1.

For skipped blocks, which are the 0-motion, 0-residue error blocks in B- and P-frames, no operations are necessary, as the watermark inserted in the anchor frame will be carried over.

For control of the final bit rate one or more of the following features can be included:

1. Quantize/inverse-quantize the DCT coefficients of the watermark so that most high-frequency coefficients will become zero. The result is a coarser watermark, using fewer bits.

2. Cut off high-frequency coefficients. The effect is similar to low-pass filtering in the pixel domain. There results a smoother watermark with more rounded edges.

3. Motion vector selection, setting the motion vector of a micro-block in P-frame to 0 when the error residue from using motion compensation of this motion vector is larger than without its use.

If the motion vector is used, the residual error is
$$E'_{ij} = E_{ij} - MCDCT(w'_F, V_{Fij}) + w'_{ij};$$
otherwise set $V_{Fij} = 0$.
$$E''_{ij} = E_{ij} - MCDCT(I_F, V_{Fij}) + w'_{ij}$$
where I_F is the DCT of anchor frame.
If $|E''_{ij}| < |E'_{ij}|$, set $V_{Fij} = 0$.

Figs. 2a, 2b and 2c illustrate the use of the adaptive watermarking techniques. Fig. 2a shows the original watermark mask. While a binary version is shown here, the algorithm is capable of handling gray scale with any specified transparent color. Fig. 2b shows an

original image. Fig. 2c shows the new watermarked image.

The watermarking algorithm was tested on a HP J210 workstation, achieving a rate of 6 frames/second. Most of the computational effort went into the MC-DCT operations.
5   If all possible MC-DCT blocks were precomputed, real time performance would be possible. This would require 12 megabytes of memory for 352x240 image size.

In accordance with an aspect of the invention, preferred watermarks offer robustness in that they are not
10   easily defeated or removed by tampering. For example, if a watermark is inserted in MPEG video by the method described above, it would be necessary to recover the watermark mask, estimate the embedding locations by extensive sub-pixel block matching, and then estimate the
15   $(\bar{\alpha}, \beta)$ factors for each watermark region. In experiments, there always remained noticeable traces in the tampered video, which can be used to reject false claims of ownership and to deter piracy.

For robustness, a watermark should not be binary, but
20   should have texture which is similar to that of the scene on which it is placed. This can be accomplished by arbitrarily choosing an I-frame from the scene, decoding it by inverse DCT transform to obtain pixel values, and masking out the watermark from the decoded video frame.

25   When there is camera motion such as panning and zooming in a video sequence, an inserted watermark may be defeated by applying video mosaicing, i.e. by assembling a large image from small portions of multiple image frames. The watermark then can be filtered out as outlier.
30   However, this technique will fail when there are actually moving objects in the foreground, as the watermark will be embedded in the moving foreground objects as well. As a countermeasure in accordance with a further embodiment of the invention, a watermark can be used which appears
35   static relative to over-all or background motion. Such a

camera motion using a 2-D affine model, and then
translating and scaling the watermark using the estimated
camera motion. The affine model can be described as
follows:

The motion vectors in MPEG are usually generated by block matching: finding a block in the reference frame so that the mean square error is minimized. Although the motion vectors do not represent the true optical flow, it is still good in most cases to estimate the camera parameters in sequences that do not contain large dark or uniform regions.

When the distance between the object/background and the camera is large, it is usually sufficient to use a 6 parameter affine transform to describe the global motion of the current frame,

$$\begin{bmatrix} u \\ v \end{bmatrix} = \begin{bmatrix} 1 & x & y & 0 & 0 & 0 \\ 0 & 0 & 0 & 1 & x & y \end{bmatrix} \cdot \begin{bmatrix} a_1 & a_2 & a_3 & a_4 & a_5 & a_6 \end{bmatrix}^T$$

where (x,y) is the coordinate of a macroblock in the current frame, $\begin{bmatrix} u & v \end{bmatrix}^T$ is the motion vector associated with that macroblock, $\begin{bmatrix} a_1 & a_2 & a_3 & a_4 & a_5 & a_6 \end{bmatrix}^T$ is the affine transform vector. We denote U for $\begin{bmatrix} u & v \end{bmatrix}^T$, X for $\begin{bmatrix} 1 & x & y & 0 & 0 & 0 \\ 0 & 0 & 0 & 1 & x & y \end{bmatrix}$, and a for $\begin{bmatrix} a_1 & a_2 & a_3 & a_4 & a_5 & a_6 \end{bmatrix}^T$.

Given the motion vector for each macroblock, we find the global parameter using the Least Squares (LS) estimation, that is to find a set of parameter a to minimize the error between the motion vectors estimated in (1) and the actual motion vectors obtained from the MPEG stream.

$$S(a) = \sum_x \sum_y [(\hat{u}_{xy} - u_{xy})^2 + (\hat{v}_{xy} - v_{xy})^2]$$

where $\begin{bmatrix} \hat{u} & \hat{v} \end{bmatrix}^T$ is the estimated motion vector. To solve for a, set the first derivative of $S(a)$ to 0, then we get

$$\begin{bmatrix} N & A & B \\ A & C & E \\ B & E & D \end{bmatrix} \cdot \begin{bmatrix} a_1 \\ a_2 \\ a_3 \end{bmatrix} = \begin{bmatrix} U_1 \\ U_2 \\ U_3 \end{bmatrix} \text{ and } \begin{bmatrix} N & A & B \\ A & C & E \\ B & E & D \end{bmatrix} \cdot \begin{bmatrix} a_4 \\ a_5 \\ a_6 \end{bmatrix} = \begin{bmatrix} V_1 \\ V_2 \\ V_3 \end{bmatrix}$$

where,

$$N = \sum_x \sum_y 1, \ A = \sum_x \sum_y x, \ B = \sum_x \sum_y y,$$

$$C = \sum_x \sum_y x^2, \ D = \sum_x \sum_y y^2, \ E = \sum_x \sum_y x \cdot y,$$

$$U_1 = \sum_x \sum_y u_{xy}, \ U_2 = \sum_x \sum_y u_{xy} \cdot x, \ U_3 = \sum_x \sum_y u_{xy} \cdot y,$$

$$V_1 = \sum_x \sum_y v_{xy}, \ V_2 = \sum_x \sum_y v_{xy} \cdot x, \ V_3 = \sum_x \sum_y v_{xy} \cdot y.$$

All summations are over all valid macro-blocks whose motion vectors survive after the nonlinear noise reduction process. After the first LS estimation, motion vectors that have large distance from the estimated ones are

5 filtered out before a second LS estimation. The estimation process is iterated several times to refine the accuracy.

Dominant motion can be estimated using clustering as follows:

10 For each B- or P-frame, obtain the forward motion vectors.

Assign each motion vector to one of a number (e.g. 4) of pre-defined classes.

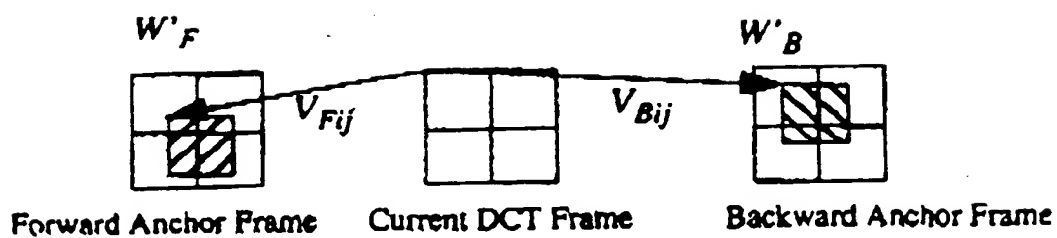Perform one round of global affine parameter

15 estimation.

Assign the global affine parameter to the first class and assign zero to all other classes.

Iterate a number of times, e.g. 20, or until the residual error is stabilized: assigning each motion vector

20 to the class that minimizes Euclidean distance and recalculating the 2-D affine parameters for each class using its member motion vectors.

CLAIMS

1. A method for including a watermark in a digital image, comprising:

obtaining digital data of a transformed representation of the image;

determining a transformed representation of the watermark for optimized visibility of the watermark in the image; and

superposing the transformed representation of the watermark on the transformed representation of the image.

2. The method in accordance with claim 1, wherein the transformed representation of the image is a compressed representation.

3. The method in accordance with claim 1, wherein the transformed representation of the image is a discrete cosine transformed representation.

4. The method in accordance with claim 1, wherein the image is one of a sequence of video images.

5. The method in accordance with claim 3, wherein the transformed representation includes motion compensation.

W'_F V_{Fij} V_{Bij} W'_B

Forward Anchor Frame   Current DCT Frame   Backward Anchor Frame

Fig. 1

Top Object   Bottom Object

ACTION SPORTS
ADVENTURE

Fig. 2a

Fig. 2b

Fig. 2c

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```
┌─────────────────┐
│   OBTAIN        │
│  WATERMARK      │
│   IMAGE         │
└────────┬────────┘
         │
         ▼
┌─────────────────────────┐
│ CONVERT WATERMARK       │
│ IMAGE TO GRAY SCALE,    │
│ SET THE TRANSPARENT     │
│ REGION TO 0, W          │
└────────────┬────────────┘
             │
             ▼
┌─────────────────────────┐
│ OPTIONAL RANDOM SHIFT   │
└────────────┬────────────┘
             │
             ▼
┌─────────────────────────┐
│   W̄ = DCT(W)            │
└─────────────────────────┘
```

$$\overline{W} = DCT(W)$$

Fig. 3

4 / 5

```
                    ┌─────────────────────────┐
                    │     OBTAIN FRAME        │
                    └─────────────────────────┘
                                │
                                ▼
              ┌──────────────────────────────────┐
              │   PARTIALLY DECODE TO            │
              │  OBTAIN DCT COEFFICIENTS, E      │
              └──────────────────────────────────┘
                                │
                                ▼
     B          ◇ TYPE? ◇    P        ◇ SCENE      ◇   NO
   ◄────────                ─────►      CUT?
                     │ I                         YES
                     ▼
              ┌──────────────┐
              │  SCALE W̄      │
              └──────────────┘
                     │
                     ▼
              ┌──────────────────────────┐
              │  ADD WATERMARK W̄'         │
              └──────────────────────────┘
                     │
                     ▼
     I        ◇ TYPE? ◇
   ◄──────
  ┌────────┐       │ B, P
  │ EQ. 7  │       ▼
  └────────┘  ┌──────────────────┐
              │   EQ. 8, 9       │
              └──────────────────┘
                     │
                     ▼
              ┌──────────────────┐
              │   NEXT FRAME     │
              └──────────────────┘
```

(i)

(ii)

Fig. 4

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OBTAIN REGION

OBTAIN DC, ΣAC^2

USE EQUATION 5

NEXT REGION

Fig. 5

PATENT COOPERATION TREATY
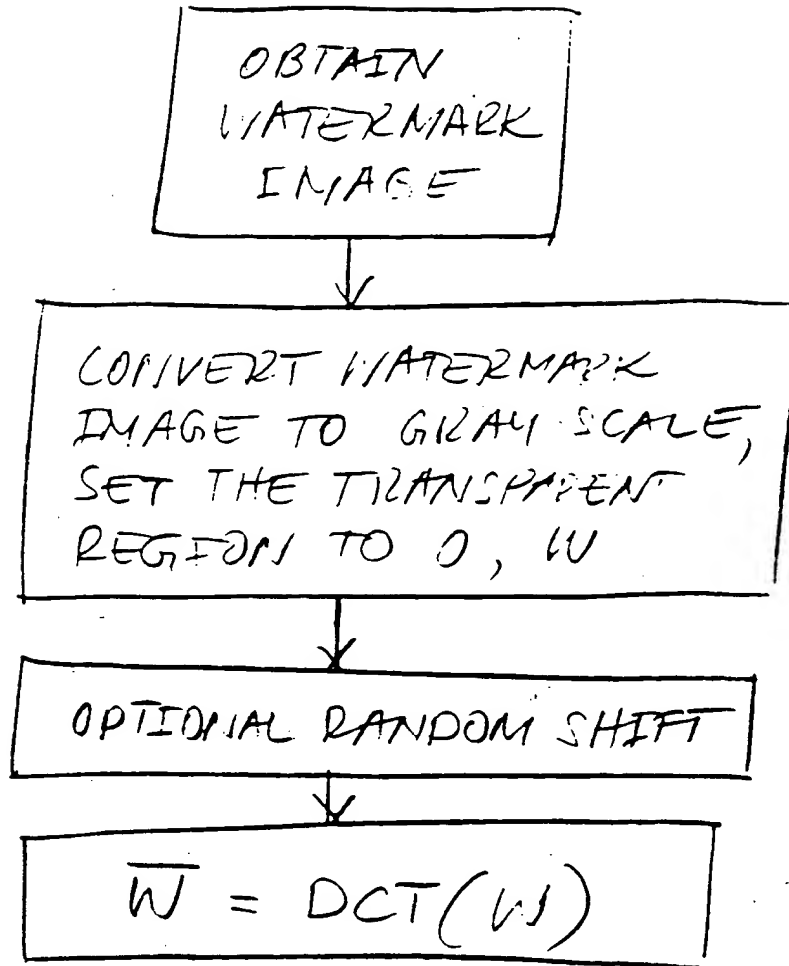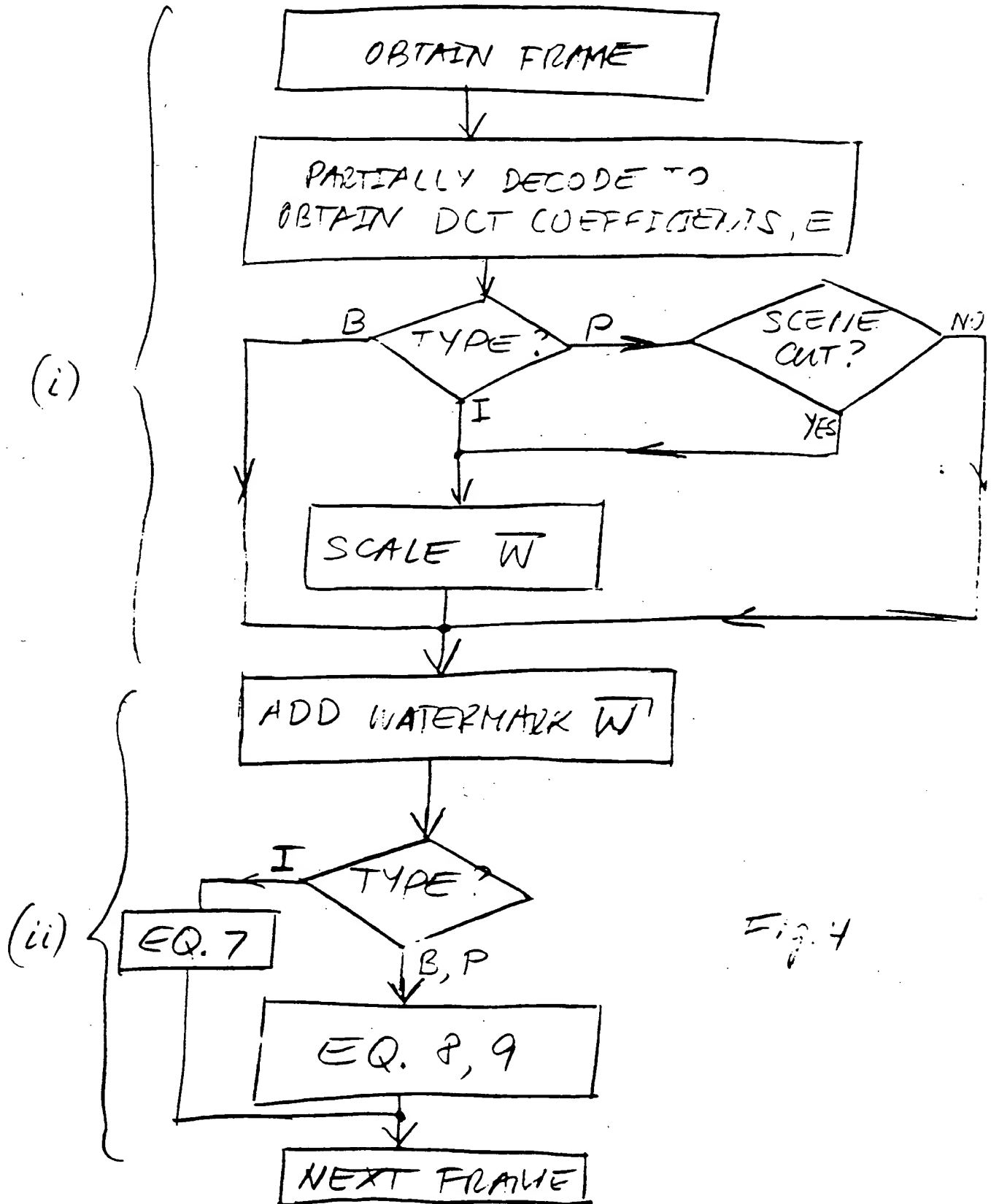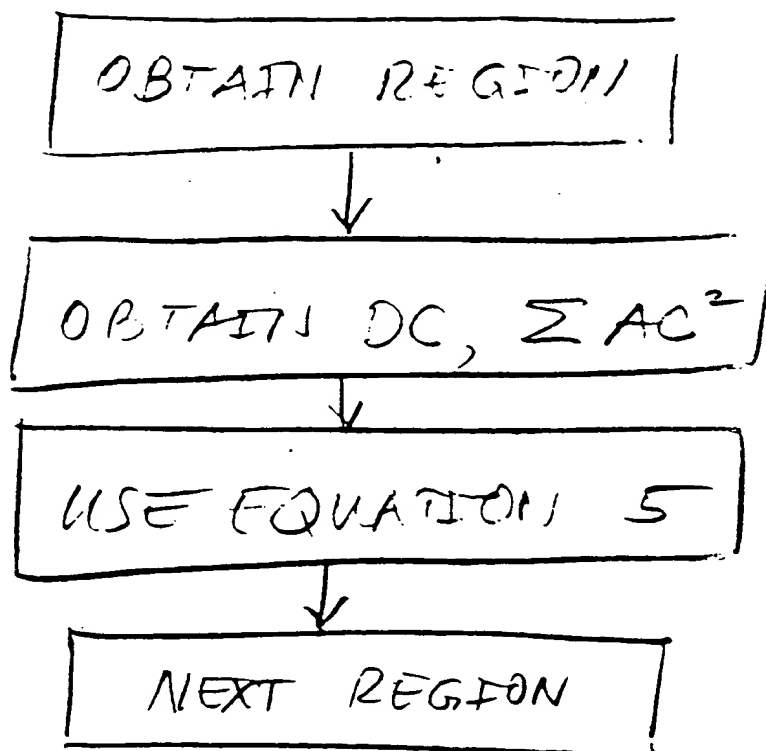
PCT

INTERNATIONAL SEARCH REPORT

(PCT Article 18 and Rules 43 and 44)

Applicant's or agent's file reference 31358-PCT	FOR FURTHER ACTION	see Notification of Transmittal of International Search Report (Form PCT/ISA/220) as well as, where applicable, item 5 below.
International application No. PCT/US98/22790	International filing date *(day/month/year)* 27 OCTOBER 1998	(Earliest) Priority Date 27 OCTOBER 1997

Applicant
THE TRUSTEES OF COLUMBIA UNIVERSITY IN THE CITY OF NEW YORK

This international search report has been prepared by this International Searching Authority and is transmitted to the applicant according to Article 18. A copy is being transmitted to the International Bureau.

This international search report consists of a total of _2_ sheets.

[X] It is also accompanied by a copy of each prior art document cited in this report.

1. [ ] Certain claims were found unsearchable (See Box I).

2. [ ] Unity of invention is lacking (See Box II).

3. [ ] The international application contains disclosure of a nucleotide and/or amino acid sequence listing and the international search was carried out on the basis of the sequence listing

    [ ] filed with the international application.

    [ ] furnished by the applicant separately from the international application,

        [ ] but not accompanied by a statement to the effect that it did not include matter going beyond the disclosure in the international application as filed.

    [ ] transcribed by this Authority.

4. With regard to the title, [X] the text is approved as submitted by the applicant.

    [ ] the text has been established by this Authority to read as follows:

5. With regard to the abstract,

    [X] the text is approved as submitted by the applicant.

    [ ] the text has been established, according to Rule 38.2(b), by this Authority as it appears in Box III. The applicant may, within one month from the date of mailing of this international search report, submit comments to this Authority.

6. The figure of the drawings to be published with the abstract is:

    Figure No. _____

    [ ] as suggested by the applicant.

    [ ] because the applicant failed to suggest a figure.

    [ ] because this figure better characterizes the invention.

    [X] None of the figures.

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INTERNATIONAL SEARCH REPORT

International application No.
PCT/US98/22790

A. CLASSIFICATION OF SUBJECT MATTER

IPC(6) :H04K 1/00; H04L 9/00; G09C 5/00
US CL :380/4; 382/100, 232; 348/589, 600, 586; 345/194, 116, 114, 113

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

U.S. : 380/4; 382/100, 232; 348/589, 600, 586; 345/194, 116, 114, 113

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

APS

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 5,530,759 A (BRAUDAWAY et al) 25 June 1996, col. 4, lines 8-67; col. 5, lines 6-65	1-5
A	US 5,664,018 A (LEIGHTON) 02 September 1997, col. 4, lines 3-67	1-5
A	US 5,488,664 A (SHAMIR) 30 January 1996, col. 3, lines 25-67; col. 4, lines 1-67	1-5
X	COX et al., Secure Spread Spectrum Watermarking for Multimedia, NEC Research Institute, Technical Report 95 - 10; pages 1-31.	1-5

☐ Further documents are listed in the continuation of Box C. ☐ See patent family annex.

* Special categories of cited documents:

"A" document defining the general state of the art which is not considered to be of particular relevance

"E" earlier document published on or after the international filing date

"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art

"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
18 DECEMBER 1998	24 FEB 1999

Name and mailing address of the ISA/US	Authorized officer
Commissioner of Patents and Trademarks Box PCT Washington, D.C. 20231	JEAN W. DESIR
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Form PCT/ISA/210 (second sheet)(July 1992)*

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NOTES TO FORM PCT/ISA/220

These Notes are intended to give the basic instructions concerning the filing of amendments under Article 19. The Notes are based on the requirements of the Patent Cooperation Treaty, the Regulations and the Administrative Instructions under that Treaty. In case of discrepancy between these Notes and those requirements, the latter are applicable. For more detailed information, see also the PCT Applicant's Guide, a publication of WIPO.

In these Notes, "Article", "Rule" and "Section" refer to the provisions of the PCT, the PCT Regulations and the PCT Administrative Instructions, respectively.

INSTRUCTIONS CONCERNING AMENDMENTS UNDER ARTICLE 19

The applicant has, after having received the international search report, one opportunity to amend the claims of the international application. It should however be emphasized that, since all parts of the international application (claims, description and drawings) may be amended during the international preliminary examination procedure, there is usually no need to file amendments of the claims under Article 19 except where, e.g. the applicant wants the latter to be published for the purposes of provisional protection or has another reason for amending the claims before international publication. Furthermore, it should be emphasized that provisional protection is available in some States only.

What parts of the international application may be amended?

Under Article 19, only the claims may be amended.

During the international phase, the claims may also be amended (or further amended) under Article 34 before the International Preliminary Examining Authority. The description and drawings may only be amended under Article 34 before the International Preliminary Examining Authority.

Upon entry into the national phase, all parts of the international application may be amended under Article 28 or, where Applicable, Article 41.

When ? Within 2 months from the date of transmittal of the international search report or 16 months from the priority date, whichever time limit expires later. It should be noted, however, that the amendments will be considered as having been received on time if they are received by the International Bureau after the expiration of the applicable time limit but before the completion of the technical preparations for international publication (Rule 46.1).

Where not to file the amendments ?

The amendments may only be filed with the International Bureau and not with the receiving Office or the International Searching Authority (Rule 46.2).

Where a demand for international preliminary examination has been/is filed, see below.

How ? Either by cancelling one or more entire claims, by adding one or more new claims or by amending the text of one or more of the claims as filed.

A replacement sheet must be submitted for each sheet of the claims which, on account of an amendment or amendments, differs from the sheet originally filed.

All the claims appearing on a replacement sheet must be numbered in Arabic numerals. Where a claim is cancelled, no renumbering of the other claims is required. In all cases where claims are renumbered, they must be renumbered consecutively (Administrative Instructions, Section 205(b)).

The amendments must be made in the language in which the international application is to be published.

What documents must/may accompany the amendments ?

Letter (Section 205(b)):

The amendments must be submitted with a letter.

The letter will not be published with the international application and the amended claims. It should not be confused with the "Statement under Article 19(1)" (see below, under "Statement under Article 19(1)").

The letter must be in English or French, at the choice of the applicant. However, if the language of the international application is English, the letter must be in English; if the language of the international application is French, the letter must be in French.

The letter must indicate the differences between the claims as filed and the claims as amended. It must, in particular, indicate, in connection with each claim appearing in the international application (it being understood that identical indications concerning several claims may be grouped), whether

(i) the claim is unchanged;
(ii) the claim is cancelled;
(iii) the claim is new;
(iv) the claim replaces one or more claims as filed;
(v) the claim is the result of the division of a claim as filed.

The following examples illustrate the manner in which amendments must be explained in the accompanying letter:

1. [Where originally there were 48 claims and after amendment of some claims there are 51]:
"Claims 1 to 29, 31, 32, 34, 35, 37 to 48 replaced by amended claims bearing the same numbers; claims 30, 33 and 36 unchanged; new claims 49 to 51 added."

2. [Where originally there were 15 claims and after amendment of all claims there are 11]:
"Claims 1 to 15 replaced by amended claims 1 to 11."

3. [Where originally there were 14 claims and the amendments consist in cancelling some claims and in adding new claims]:
"Claims 1 to 6 and 14 unchanged; claims 7 to 13 cancelled; new claims 15, 16 and 17 added." or
"Claims 7 to 13 cancelled; new claims 15, 16 and 17 added; all other claims unchanged."

4. [Where various kinds of amendments are made]:
"Claims 1-10 unchanged; claims 11 to 13, 18 and 19 cancelled; claims 14, 15 and 16 replaced by amended claim 14; claim 17 subdivided into amended claims 15, 16 and 17; new claims 20 and 21 added.:

"Statement under Article 19(1)" (Rule 46.4)

The amendments may be accompanied by a statement explaining the amendments and indicating any impact that such amendments might have on the description and the drawings (which cannot be amended under Article 19(1)).

The statement will be published with the international application and the amended claims.

It must be in the language in which the international application is to be published.

It must be brief, not exceeding 500 words in English or if translated into English.

It should not be confused with and does not replace the letter indicating the differences between the claims as filed and as amended. It must be filed on a separate sheet and must be identified as such by a heading, preferably by using the words "Statement under Article 19(1)."

It may not contain any disparaging comments on the international search report or the relevance of citations contained in that report. Reference to citations, relevant to a given claim, contained in the international search report may be made only in connection with an amendment of that claim.

Consequence if a demand for international preliminary examination has already been filed

If, at the time of filing any amendments under Article 19, a demand for international preliminary examination has already been submitted, the applicant must preferably, at the same time of filing the amendments with the International Bureau, also file a copy of such amendments with the International Preliminary Examining Authority (see Rule 62.2(a), first sentence).

Consequence with regard to translation of the international application for entry into the national phase

The applicant's attention is drawn to the fact that, upon entry into the national phase, a translation of the claims as amended under Article 19 may have to be furnished to the designated/elected Offices, instead of, or in addition to, the translation of the claims as filed.

For further details on the requirements of each designated/elected Office, see Volume II of the PCT Applicant's Guide.

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